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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/896,363	06/28/2001	Hong-Qiang Lu	LSI1P167/01-206	2235

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EXAMINER

TOLEDO, FERNANDO L

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 04/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/896,363

Applicant(s)

LU ET AL.

Examiner

Fernando L. Toledo

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 February 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14 and 21-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 7 and 8 is/are allowed.
- 6) ☒ Claim(s) 1-6 and 21-24 is/are rejected.
- 7) ☒ Claim(s) 9-14 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 28 June 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☐ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1 – 3, 5, 21 and 23 – 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (U. S. patent 6,486,059 B2) in view of Subramanian et al. (U. S. patent 6,465,889 B1 and in view of Sundrarajan et al. (US Patent Application Publication US 2002/0027286 A1).

In re claims 1, 3, 23 and 24, Lee discloses, in the U. S. patent 6,486,059 B2; figures 1A – 2G and related text depositing a first barrier layer 38 containing silicon carbide directly on a layer 361 having an interconnect 56'; depositing a second barrier layer 40 directly on top of the first barrier layer; forming a first low-k dielectric layer 362 over the second barrier layer; and depositing a photoresist material 44 to form a photoresist layer above at least a portion of the first low-k dielectric layer.

Lee does not show wherein the silicon carbide layer contains nitrogen. Lee also does not show wherein the second barrier layer is a nitrogen-free barrier layer.

Sundrarajan, in the US Patent Application Publication US 2002/0027286 A1; figures 1A – 2B and related text, discloses that SiCN (i.e. silicon carbonitride) has low leakage current and

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is effective in preventing the migration or diffusion of metal or copper atoms through the SiCN layer (Abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the first barrier of Lee with SiCN instead of just SiC, since, as taught by Sundrarajan, it has low leakage current and is effective in preventing the migration or diffusion of metal or copper atoms.

Lee in view of Sundrarajan does not disclose wherein the second barrier layer is a nitrogen-free barrier layer.

However, Subramanian, in the U. S. patent 6,465,889 B1; figures 1 – 8 and related text, discloses that ARC layers (like the one disclose by Lee) can be formed of nitrogen-free compounds such as SiC, since they improve damascene interconnection structures (Abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the second barrier layer of Lee with SiC since, according to Subramanian, SiC layers improve the interconnection structures of damascenes.

1. In re claim 2, Lee discloses further including patterning, and etching the photoresist layer to form a photoresist mask (Figure 2A).
2. In re claim 5, Lee in view of Sundrarajan, discloses wherein depositing a first barrier layer containing silicon carbide and nitrogen includes using PECVD process and one of NH_3 , N_2 and N_2O as a chemical precursor to supply nitrogen (Abstract of Sundrarajan).
3. In re claim 21, Lee in view of Sundrarajan and Subramanian does not disclose, wherein the thickness of the second barrier layer is approximately 25% of the thickness of the first barrier layer.

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However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have the second barrier thickness approximately 25% of the thickness of the first barrier layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. In addition, the selection of thickness, is obvious because it is a matter of determining optimum process conditions by routine experimentation with a limited number of species of result effective variables. These claims are prima facie obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. In *re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996)(claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill or art) and *In re Aller*, 105 USPQ 233 (CCPA 1995) (selection of optimum ranges within prior art general conditions is obvious). Note that the specification contains no disclosure of either the critical nature of the claimed thickness or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen thickness or upon another variable recited in a claim, the Applicant must show that the chosen thickness is critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

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4. Claims 4, 6 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee in view of Sundrarajan and in view of Subramanian as applied to claims 1 – 3, 5, 21 and 23 – 24 above, and further in view of Law (U. S. patent 6,338,874 B1).

In re claims 4 and 22, Lee in view of Sundrarajan and in view of Subramanian, does not disclose wherein the process tool used to deposit the first barrier layer is used to deposit the nitrogen-free barrier layer.

However, Law, in the U. S. patent 6,338,874 B1; figures 1 and 2 and related text, discloses that this process (i.e. one chamber process) eliminated one or more transfers of the large substrates between reaction chambers (Column 2, Lines 10 – 12).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the two barrier layers of Lee in view of Sundrarajan and Subramanian in the same chamber, since as taught by Law, it eliminates one or more transfers of the large substrates between reaction chambers.

5. In re claims 6 and 22, Lee in view of Sundrarajan, Subramanian and Law discloses wherein depositing a nitrogen-free second barrier layer includes the PECVD process recited in claim 5 and turning off the supply of nitrogen.

Claim Objections

6. Claims 9 – 14 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Allowable Subject Matter

7. Claims 7 and 8 are allowed over the prior art of record.

Response to Arguments

8. Applicant's arguments filed 23 February 2004 have been fully considered but they are not persuasive for the following reasons.

9. Applicant contests that Lee does not teach forming a barrier layer of silicon carbide on a layer having an interconnect structure. Applicant also contests that the layer of Lee is not a barrier layer but an etch stop layer.

Examiner respectfully submits that the layer 38 of Lee is formed on top of layer 361 that has part of the interconnect structure 56', therefore, the layer 38 of Lee is formed directly on a layer having an interconnect. Examiner also respectfully submits that the layer of Lee will inherently also be a barrier layer, since it is formed of the same materials as that of the instant application (i.e. a silicon carbide layer). It is not necessary for the reference to disclose that the process of the reference is performed to achieve the same goals as applicant or to obtain the same advantages recognized by applicant. It is sufficient that the process suggested by the reference alone or in combination with the remaining references is encompassed by the instant claims.

Conclusion

10. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

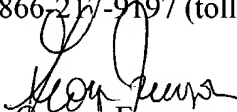
A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.


Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fernando L. Toledo whose telephone number is 571-272-1867. The examiner can normally be reached on Mon-Thu 7am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


George Fourson
Primary Examiner
Art Unit 2823


FToledo
27 April 2004